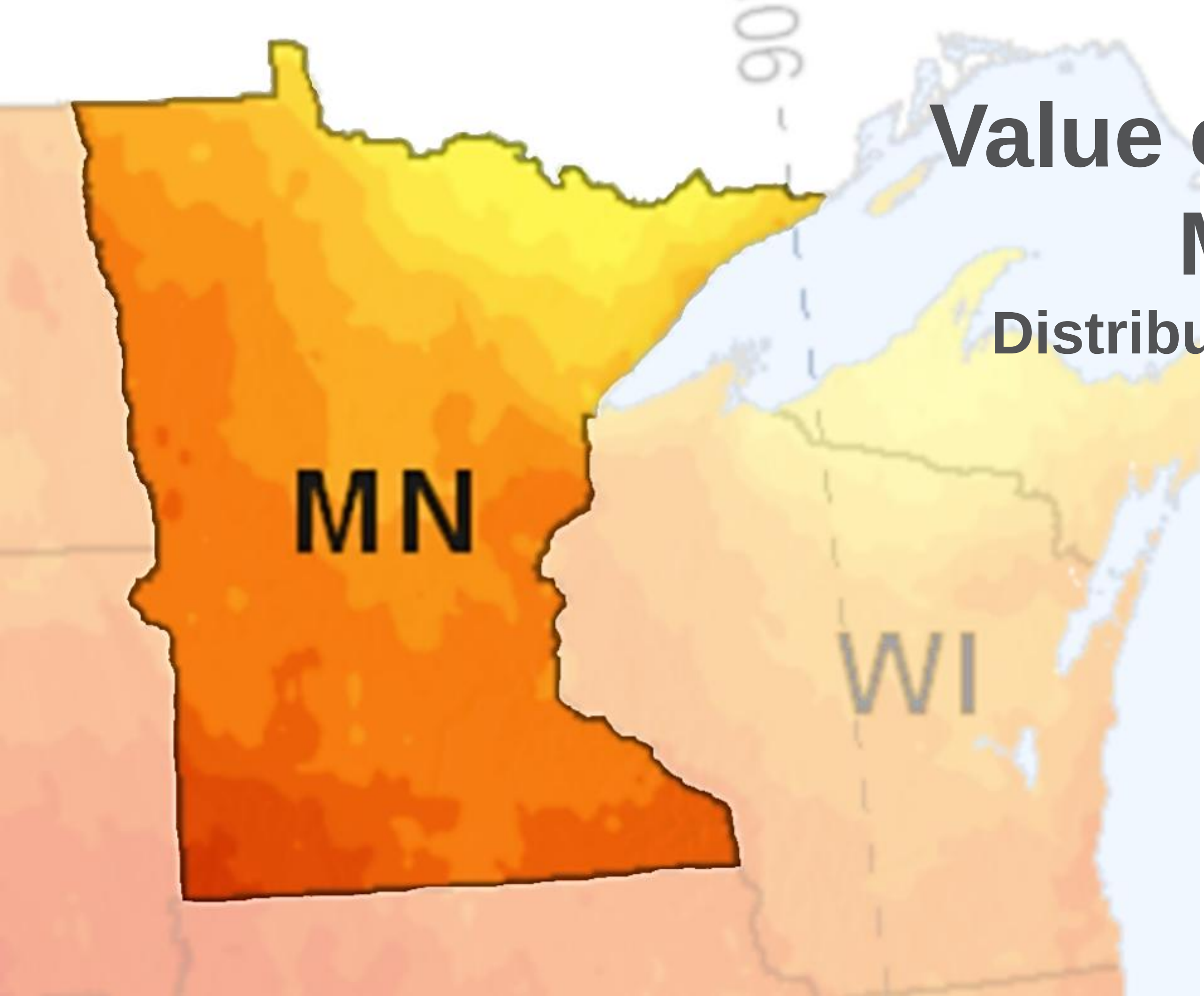
Value of Solar Tariff Methodology:

Distribution Capacity Value



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Prepared for

Minnesota Department of Commerce, Energy Division

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Clean Power Research

What is Distribution Capacity Value?

- Definition

  The benefit that distributed PV provides in reducing the peak load on the distribution system, thereby delaying need for capital investment in new distribution capacity

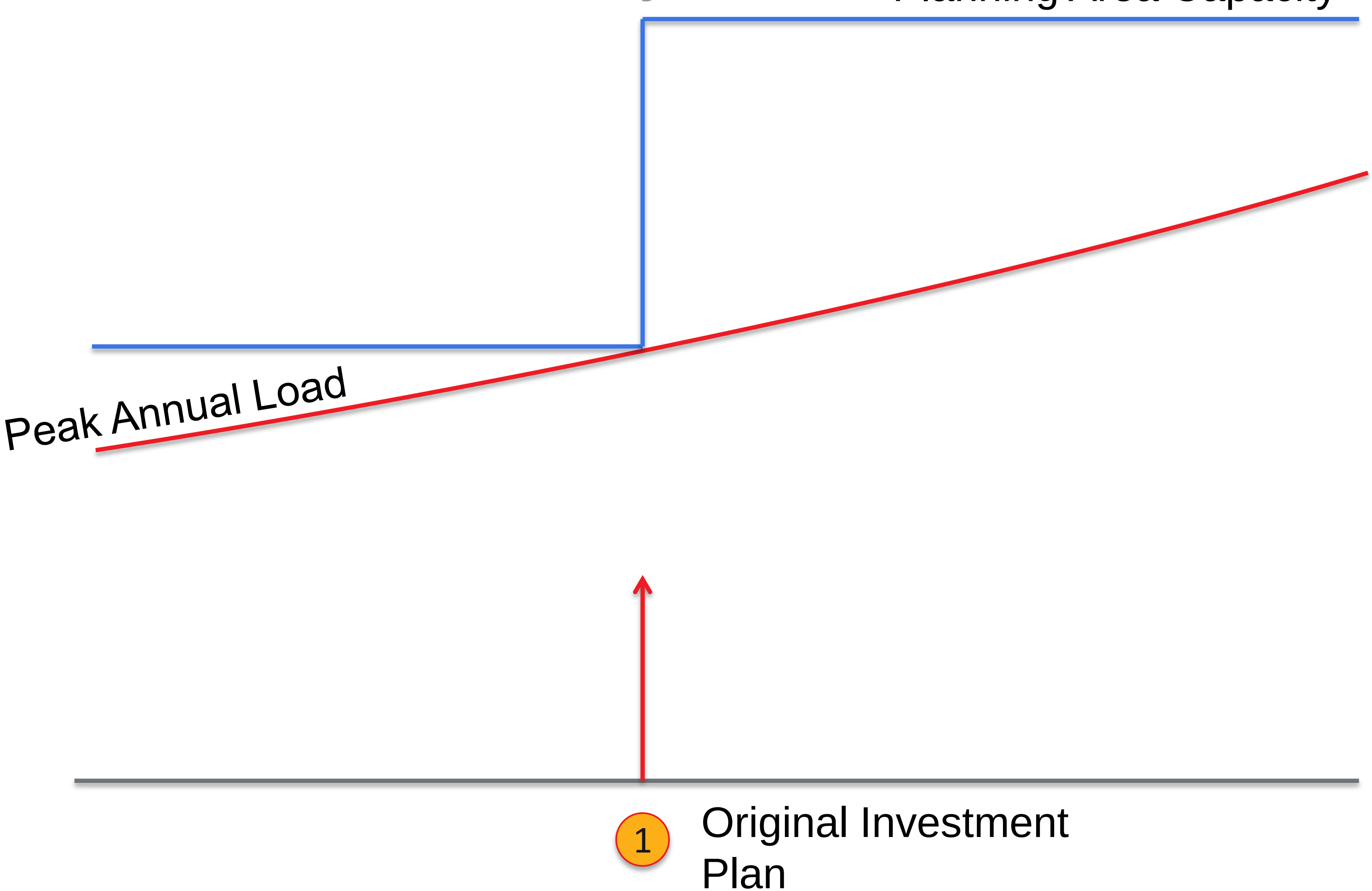
- Basis for cost savings

  The utility saves financial costs– interest on bonds and returns to shareholders– during the time that the investment is deferred

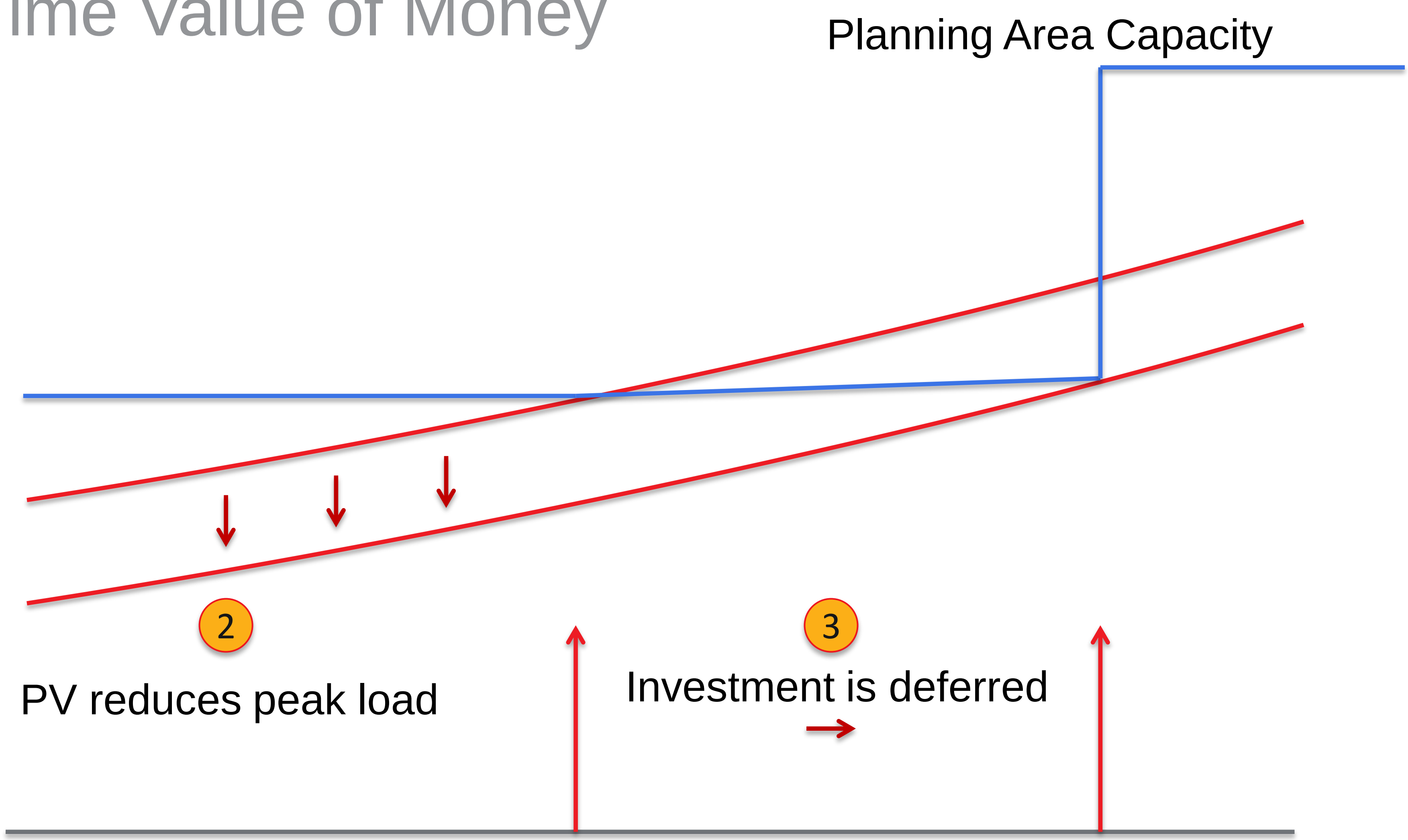
- Methodology Overview

  1. Estimate the present value of long-term capacity-related capital investments (25 years)
  2. Estimate load growth
  3. Calculate the “effective capacity” of PV (the direct ability of PV to reduced the distribution peak load)
  4. Distribution capacity value equals the total long term investment, divided by load growth, times a financial term, times the peak load reduction capability

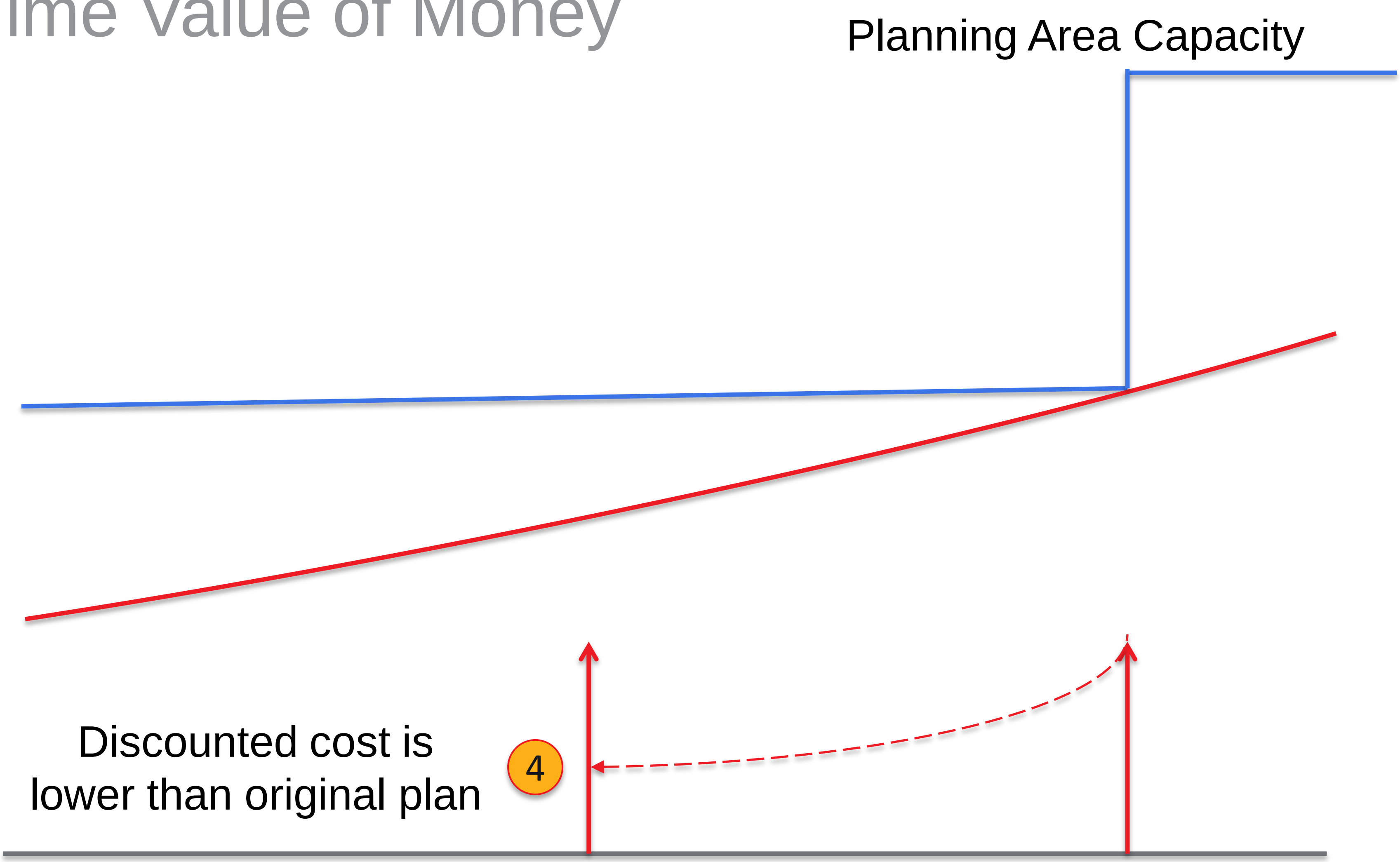
Time Value of Money



Time Value of Money

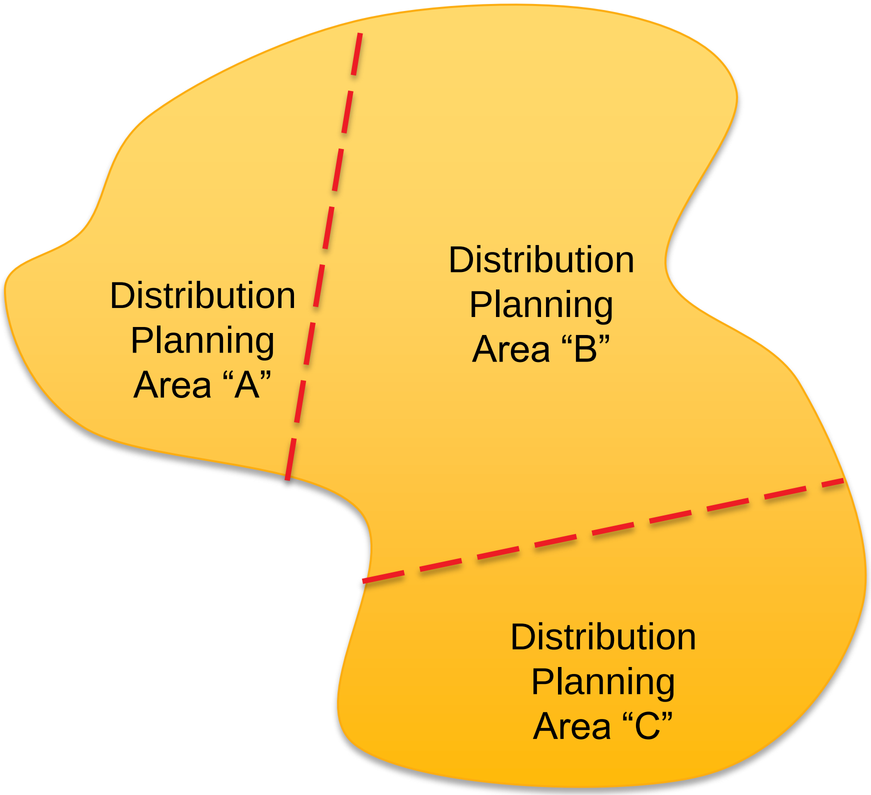


Time Value of Money



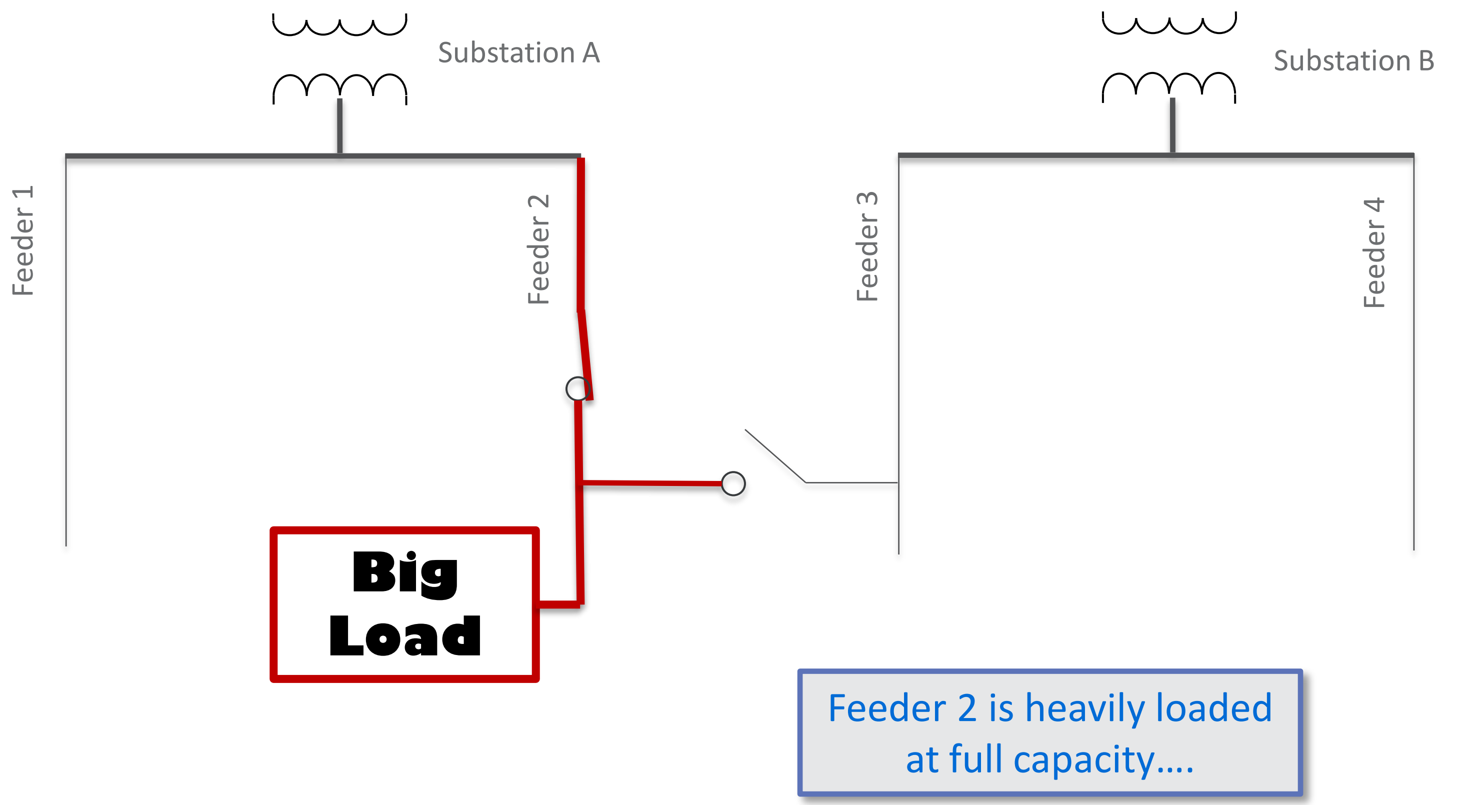
System-wide VOS, or location-specific VOSs?

- System wide analysis
  - Include system-wide distribution costs
  - Evaluate match of system-wide PV fleet across system-wide load
  - A single VOS applies for whole system
- Location-specific VOS
  - Planning Area = Isolated region, no external load transfers
  - Conduct separate analysis for each location (PV resource, cost, load match, growth rate)
  - Separate VOS results for each location.



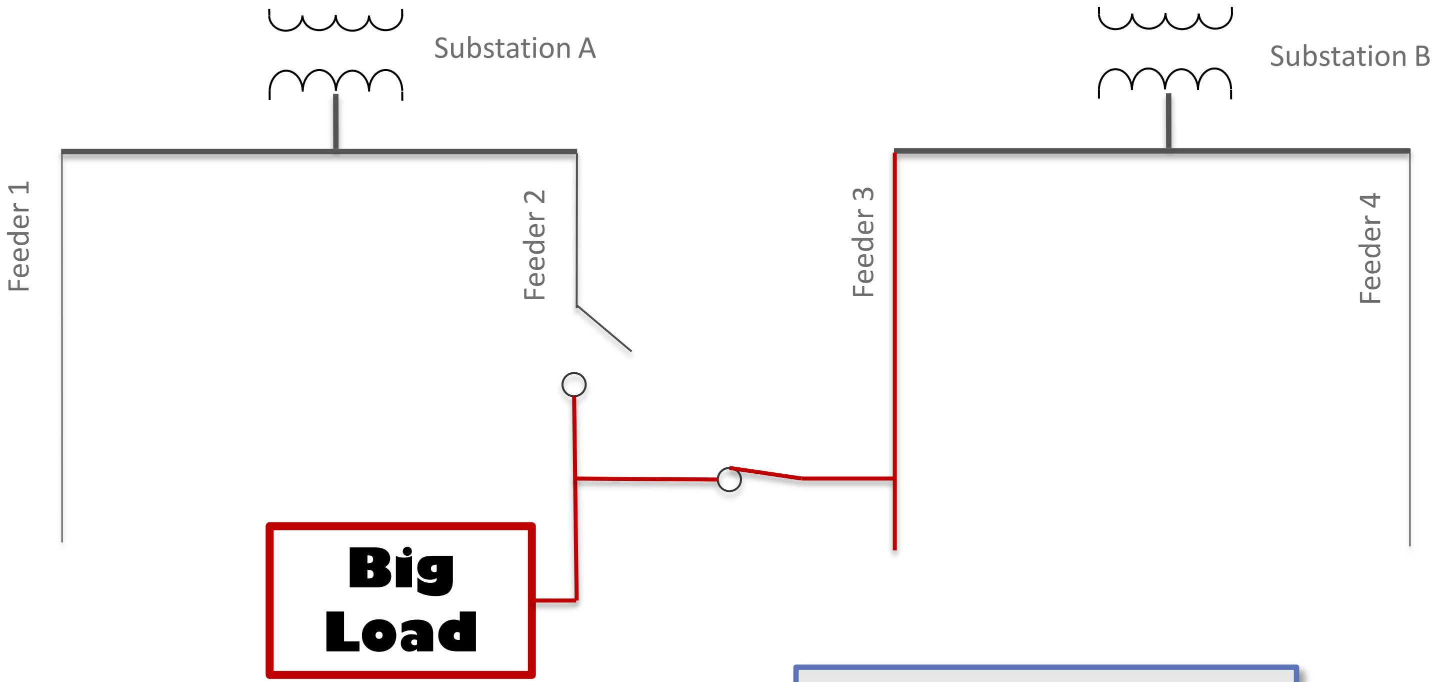
Location-specific: Distribution Planning Areas

Smallest area in which capacity cannot be met by load transfer



Location-specific: Distribution Planning Areas

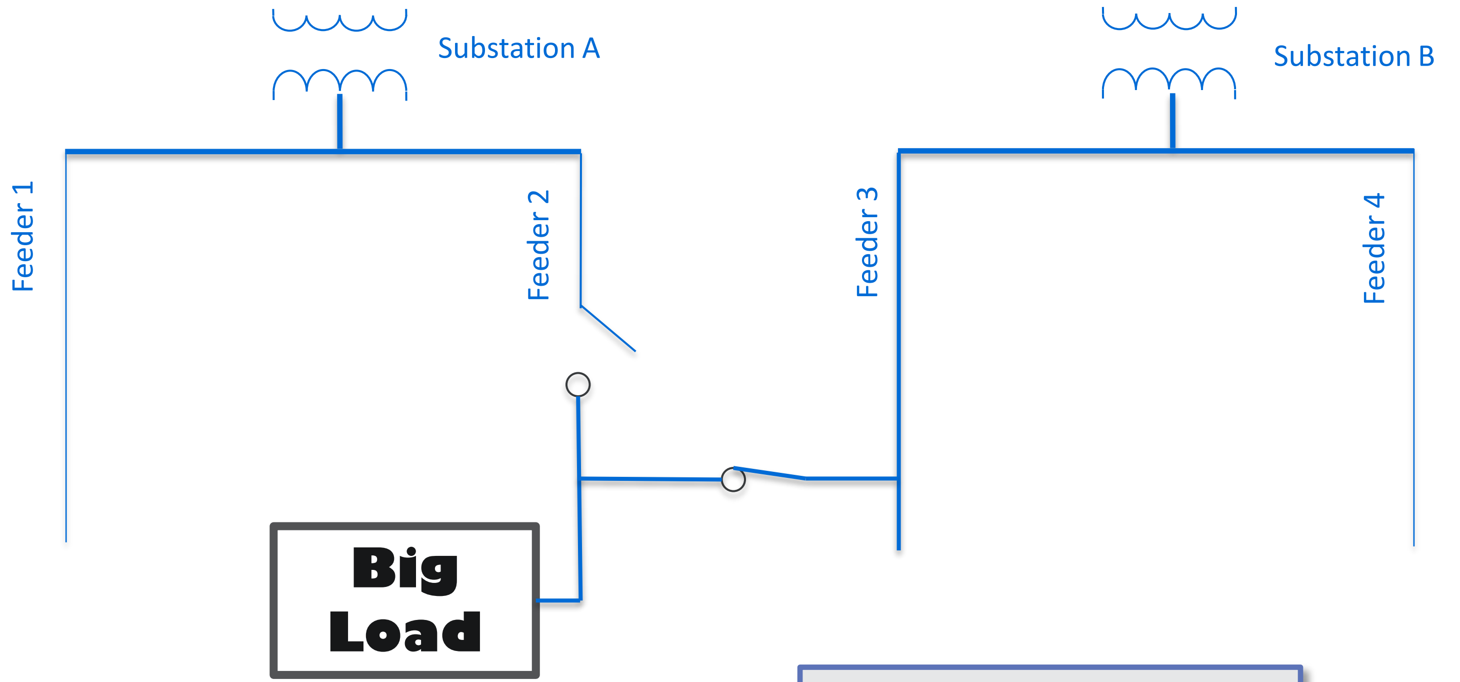
Smallest area in which capacity cannot be met by load transfer



… but Feeder 3 can handle part of it.

Location-specific: Distribution Planning Areas

Smallest area in which capacity cannot be met by load transfer



Therefore distribution planning area includes two substations and four feeders.

What Costs Should Be Included in the Distribution Capacity Value Calculation?

- Only capital costs
- Only equipment that PV can defer/avoid (“capacity related”)

Example 1: SCADA Communications Gear

Analysis: This equipment is needed to provide operators with real-time information about the grid. It is needed whether PV is present or not.

Conclusion: Do not include this as a deferrable cost.

Example 2: Substation Transformer

Analysis: This equipment is needed to serve all load in the area. If the load reaches the transformer capacity limit, it has to be replaced with a larger unit. DG can reduce the load on this equipment and potentially delay the investment of a new unit.

Conclusion: Include this as a potentially deferrable cost (depends on load match).

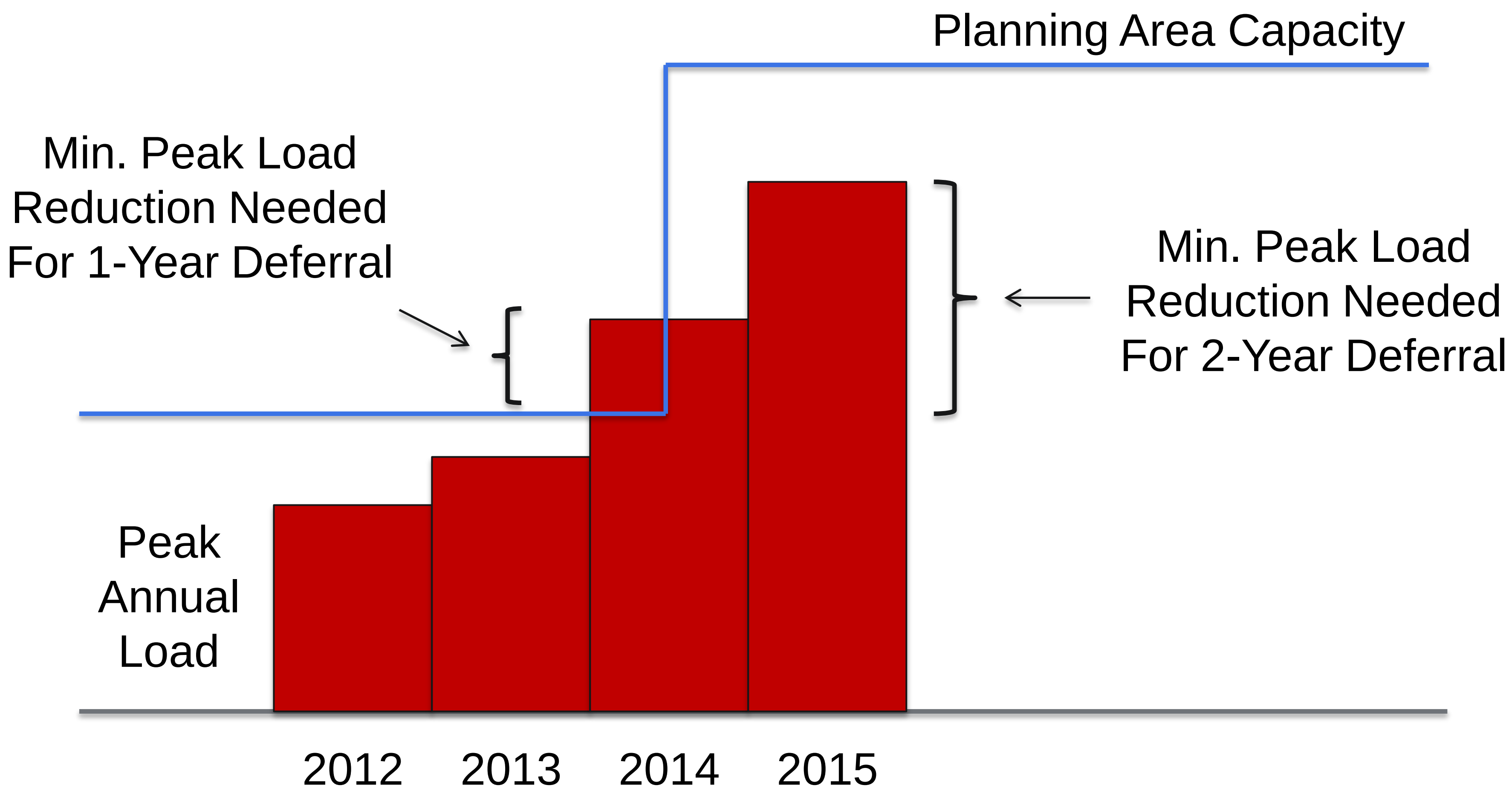
Example Account Evaluation

Xcel Energy / Northern States Power, 2012 (cost data submitted to FERC)

Account	Account Name	Additions ($) [A]	Retirements ($) [R]	Net Additions ($) = [A] - [R]	Capacity Related?	Deferable ($)
	DISTRIBUTION PLANT					
360	Land and Land Rights	13,931,928	233,588	13,698,340	**100%**	13,698,340
361	Structures and Improvements	35,910,551	279,744	35,630,807	**100%**	35,630,807
362	Station Equipment	478,389,052	20,808,913	457,580,139	**100%**	457,580,139
363	Storage Battery Equipment					
364	Poles, Towers, and Fixtures	310,476,864	9,489,470	300,987,394		
365	Overhead Conductors and Devices	349,818,997	22,090,380	327,728,617	**25%**	81,932,154
366	Underground Conduit	210,115,953	10,512,018	199,603,935	**25%**	49,900,984
367	Underground Conductors and Devices	902,527,963	32,232,966	870,294,997	**25%**	217,573,749
368	Line Transformers	389,984,149	19,941,075	370,043,074	**10%**	37,004,307
369	Services	267,451,206	5,014,559	262,436,647		
370	Meters	118,461,196	4,371,827	114,089,369		
371	Installations on Customer Premises	22,705,193		22,705,193		
372	Leased Property on Customer Premises					
373	Street Lighting and Signal Systems	53,413,993	3,022,447	50,391,546		
374	Asset Retirement Costs for Distribution Plant	15,474,098	2,432,400	13,041,698		
TOTAL		3,168,661,143	130,429,387	3,038,231,756		**$ 893,320,481**

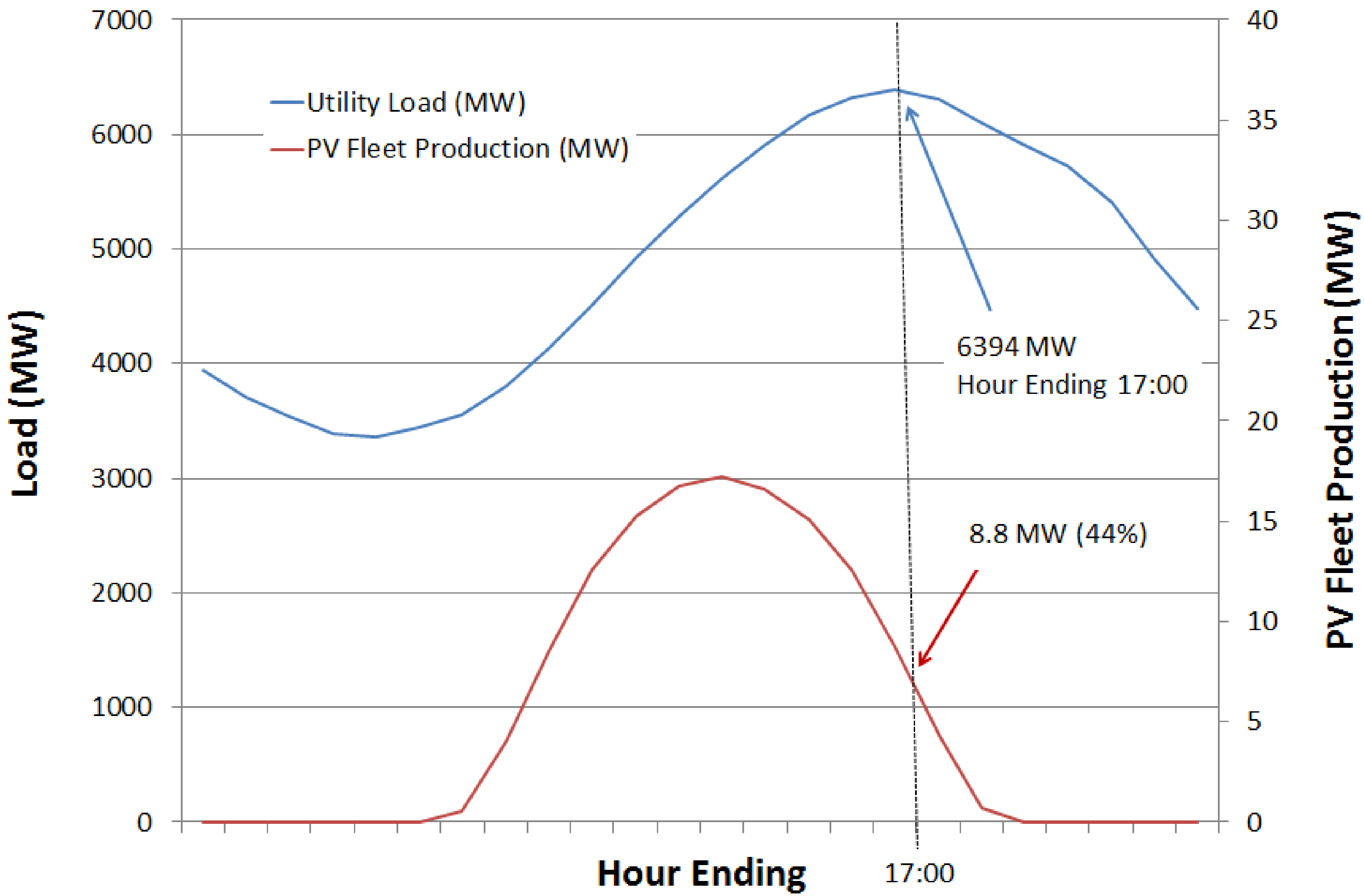
Est. 28% of distribution 2012 capital investments
were potentially deferrable by DG

Lumpiness



Planning Area Capacity
Min. Peak Load Reduction Needed For 1-Year Deferral
Min. Peak Load Reduction Needed For 2-Year Deferral
Peak Annual Load
2012
2013
2014
2015

Peak Load Reduction (PLR)



Peak Load Reduction (PLR)

- PLR is a measure of effective capacity for distribution capacity value (ELCC is not used)
- Calculated as the maximum annual load without PV minus the maximum annual load with PV
- PLR includes distribution loss savings, but not transmission loss savings
- Very conservative: if PV is not producing on the peak hour, it gets no credit
- Acceptable to most distribution engineers

Two Example Calculations

- System-wide value
  - Assumes $200 per kW distribution costs (methodology would include detail to show how to calculate cost per unit of growth)
  - Extrapolates growth based on historical data (historical analysis not shown), assumed to be 1% per year
  - New capacity added each year to account for growth
  - Assumes that lumpiness requirement is met
- Location-specific value
  - Assumes $400 per kW (high cost area)
  - Assumes that 2 MW of effective capacity can defer investment of a 10 MW capacity increase for 2 years (corresponds to growth rate of 1 MW/yr).
  - Assumes a second 10 MW investment is required in another 15 years

Two Example Calculations

Assumptions Common to Both Examples

Capital Cost Escalation	2%
Discount Rate	8%
Peak Load Reduction (PLR)	80%
PV Energy (kWh/kW-AC)	1500

Example Calculation

System-wide Distribution Value

Year	Capital Cost ($/kW)	Peak Load (MW)	New Capacity (MW)	Capital Cost ($)	Disc. Capital Cost ($)
Base		5,000			
0	$200	5050	50	$10,000,000	$10,000,000
1	$204	5101	51	$10,302,000	$9,538,889
2	$208	5152	51	$10,613,120	$9,099,040
3	$212	5203	52	$10,933,637	$8,679,473
	. . .				
22	$309	6286	62	$19,243,054	$3,539,577
23	$315	6349	63	$19,824,194	$3,376,363
24	$322	6412	63	$20,422,885	$3,220,675
					$150,242,172
			[A]	Total PW Capital Cost	$150,242,172
			[B]	Load Growth (kW/yr)	50,000
			[C]	Financial Factor	6%
			[D]	PLR (kW/kW-AC)	0.80
			= { [A]/[B] } x [C] x [D]	Deferral Value ($/kW-AC)	$134
				Deferral Value (Lev. $/kWh)	$0.008

Example Calculation

Location-specific Value

	Original Plan			Deferred Plan (2 year deferral)		
Year	New Capacity (MW)	Capital Cost ($)	Disc. Capital Cost ($)	New Capacity (MW)	Capital Cost ($)	Disc. Capital Cost ($)
0						
1						
2	10	$4,161,600	$3,567,901			
3						
4				10	$4,329,729	$3,182,480
5						
• • •						
16						
17	10	$5,600,966	$1,513,767			
18						
19				10	$5,827,245	$1,350,243
20						
21						
22						
23						
24						
			$5,081,668			$4,532,723

Example Calculation

Location-specific Value

Original Plan	$5,081,668
Deferred Plan	$4,532,723
Savings	$548,946
Required Capacity (MW)	2.0
PV Capacity (MW-AC)	2.5
Deferral Value (Lev. $/kWh)	$0.013

Implementation of Location-Specific Values

Further Considerations

- Customers would receive different VOS rates, depending on location.
- Will provide a means for utilities to encourage solar adoption in areas of greatest benefit.
- Utilities have to define distribution planning area(s) and map them for use by solar applicants.
- Analysis will be required <u>for each planning area</u>:
  - Develop distribution plan, and obtain engineering cost estimates
  - Perform loss analysis to obtain average and peak losses
  - Obtain technical data (hourly loads and peak growth rates) for aggregated feeders
  - Model solar mini-fleet using local solar resource data
- Utility will have no basis for estimating future costs beyond known planning phase. In the example, if the second 10 MW increase in year 17 was not included, the value would have gone down. This will have to be developed further.
- Possibly establish threshold limit (e.g., 10 MW new aggregate capacity by 18 months or distribution value will not be included). VOS applicants would not know final VOS rate. Utilities would have to track installations by planning area.
- The number of VOS rates will increase, adding administrative complexity.